ANALYSIS OF ECONOMIC FACTORS AFFECTING SUCCESS OF OPERATIONS OF SELECTED MIDWESTERN PETROLEUM COOPERATIVES

by

BYRON EUGENE TAYLOR

B. S., Kansas State College
of Agriculture and Applied Science, 1955

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Economics and Sociology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1958

LD
2668
T4
1958
T38
c.2
Documents.

TABLE OF CONTENTS

INTRODUCTION 1

PURPOSE OF STUDY 2

REVIEW OF LITERATURE 3

SCOPE AND METHOD 7

ANALYSIS OF ECONOMIC FACTORS RELATIVE TO SUCCESS 9

- Measuring Degree of Success 9
- Selection of the Variables that Influence Degree of Success 13
- Extension of Credit 13
    - Measuring Credit Extension 14
    - Analysis of All Associations 14
    - Analysis of Small Associations 18
    - Analysis of Large Associations 19
    - Summary and Conclusions 21
- Size of Business 21
    - Measuring Size of Business 22
    - Simple Linear Regression Analysis 22
    - Multiple Regression Analysis 24
    - Chi Square Analysis 26
    - Relation to Gross Margin and Total Expenses 28
    - Summary and Conclusions 30
- Investment in the Local Cooperative 30
    - Simple Linear Regression Analysis 31
    - Multiple Regression Analysis 32
    - Summary and Conclusions 33

Other Factors Affecting Degree of Success 34

  Gross Margin 34

  Total Expenses 37

  Summary and Conclusions 39

SUMMARY AND CONCLUSIONS 40

ACKNOWLEDGEMENT 45

REFERENCES 46

APPENDICES 47

INTRODUCTION

A cooperative is an institution which has as its foundation a group reaction to an economic problem. The success of a cooperative is influenced by both economic and non-economic problems.

The economic problem may be sighted as two general areas. First is commercial success with which any retail firm is faced. Second is the nature of the sphere in which a cooperative firm is contained.

Commercial success is the area that may be measured from information contained within the firm's balance sheet and operating statement. Commercial success of a cooperative has been studied in the past by comparison studies and factor analysis. These methods have proved useful to cooperative advisors and have introduced some measures of commercial success. Comparative and factor analyses, however, are limited by the assumption that the variable being studied is the only factor influencing success. The goal of this study is to use more powerful tools in determining a variable's influence on success.

The business world that cooperatives face has made certain requirements that petroleum firms must meet. These requirements converge into a general business policy of obtaining sufficient returns above expenses to permit them to remain in operation. Petroleum cooperatives are such concerns and are in competition with other retail business firms to sell petroleum products. This competition creates problems which are requiring the attention of cooperative leaders and advisors. There is a growing interest in finding measurements and aids in determining a cooperative's chances of meeting these requirements of operation.

What contributes to success in operations of petroleum cooperatives? What effect does size of business have on success? These questions and others have not been completely answered in the past. This study is to answer some of these questions in such a way that cooperative planners and advisors may translate these answers into a quantitative form. Quantitative answers should be useful to future cooperative ventures.

The nature of the sphere in which cooperatives operate is somewhat different from that of private retail firms. The goal of farmer cooperatives is assumed here to be to maximize returns of members. The farmer cooperative is considered by the farmer member as one alternative investment of the many alternatives he might consider in his farming enterprise. This sphere is, therefore, influenced by the member's loyalty and ability, by the risks of nature, by management and organization and by many other influences which are difficult to measure quantitatively. This sphere is considered to be of random influence in this study because, although the influence of the sphere is contained within the balance sheet and operating statement, it cannot be calculated from the firms' balance sheets or operating statements.

It is recognized that there are sociological aspects of cooperatives which influence success. However, this study is limited to economic aspects of success and specifically to those related to commercial success.

PURPOSE OF STUDY

The purpose of this study was to find what factors were actually affecting the success of a cooperative petroleum association. The data used in this study were limited to the balance sheet and operating statement of the individual cooperative for the fiscal year 1952-1953. From these data an objective look was taken to find what economic factors are actually affecting the success of a cooperative. With this information some practical application and usable answers might be given to the questions being asked by cooperative advisors such as:

1. What affect does extension of credit have on success?
2. What affect does size of business have on success?
3. What other factors are influencing success and how important are they?

This study is not to detract from other studies done before it, but to supplement them by showing what was happening in selected individual cooperatives to make them effective in obtaining economic goals.

REVIEW OF LITERATURE

Economic efficiency of petroleum cooperatives has been studied with the tool of comparative analysis. Very little has been done with the more powerful tools of statistics, such as linear regression and multiple regression. The following review consists largely of comparative analysis of the economic efficiency of petroleum cooperatives.

A review of literature was made to correspond with the objectives of this study. The first objective was to determine a measure of success or efficiency of the association.

Koller and Jesness (3) stated that in Minnesota "a valuable indicator of general efficiency of cooperative oil associations is the amount of net income for each dollar of sales." This indicator is used as part of a effectiveness index in this study.

Koller and Jesness (3) further stated that "average statements are presented as an aid to individual associations in comparing the operating results of one organization with those of associations which are distinctively above or below the average." This type of comparison is done by use of a effectiveness index based on the median of all association's rate of savings (percent operating savings is of sales) and rate of return (percent return operating savings is on investment in the cooperative).

The second objective was to determine the effect of extension of credit on success.

Knapp and Hyre (2) stated that "associations which have accounts outstanding equal to 60 or more days' sales generally show higher operating costs and smaller net gains than associations with smaller amounts in accounts receivable." "The operating costs were lowest for associations having 30 or less days' sales in accounts receivable." This study is limited to averages and comparative analysis of these averages.

Knudtson and Koller (4) stated that in Minnesota "credit sales averaged approximately 50 percent of all supply sales in 1953 study." "Days' credit sales in accounts receivable is a valuable measure because it includes only the credit problem." "The magnitude of the ratio may be compared directly with the credit terms." This means that if the policy of a cooperative is 30 days' credit, the days' sales in accounts receivable should correspond with this or investigation into the account is necessary. The use of days of sales in accounts receivable is a good and self-explanatory way of expressing the amount of credit extended. The proper use of this term and proper understanding of the term will facilitate management decisions.

Teachout (7) stated "stingy credit practices and cash-on-the-barrel-head attitude are as bad as inadequate stocks or poor merchandise." He also noted that accounts reaching a period of 60 days or more ceased to be of service to the farmer and became a contingent liability to the firm. The proper use of extension of credit geared to the customers of the business is the essence of this work.

The third objective of this study was to determine the effects of size of business on success.

Koller and Jesness (3) stated that in Minnesota "Net income per dollar sales varied significantly with sales volume." The method used was comparison of the average net income for different size groups, or comparison and factor analysis, which is limited to showing the effect one factor has on another as if it were the only factor.

Jenkins (1) stated that in Mississippi "there was some relation between size of business and net margin." "The associations making up the lower one-fourth of net margin had a larger average volume than any other group." "This would indicate that the larger size associations were in the lower one-fourth in obtaining net margins, by use of averages." This study indicates that size of business is related to net margin but in an inverse relationship as to what was indicated earlier in this section. This could be due to the services offered and large associations' lower margins.

Manning and Koller (5) stated that in Minnesota "net margin was affected to some extent by business volume." "Net margin depended on management policies to a large extent." The smaller volumes had more large net margins than did the larger volumes by groups. This study suggests the same idea as was presented above in Mississippi about the inverse relationship of net margin and volume of business. This suggests that there are other factors related to net margin which aren't as easily measured as volume of business.

There have been a number of studies done suggesting that expenses and gross margin vary randomly with size of business.

Manning and Koller (5) stated that in Minnesota "volume of business alone seemed to have little effect on expense ratios." This would seem to suggest that size of business would not yield economies of scale.

Knapp and Hyre (2) stated "the larger associations had considerably higher gross margins and slightly higher expense ratios than smaller associations." This was due to services rendered and not to volume of business.

Jenkins (1) stated in Mississippi "there was no consistent relation between volume and expenses." "The large volume associations were either in the most efficient or the least efficient group." The total number of associations were divided into four groups.

The fourth objective of this study was to determine what other factors affect success of an association. It is indicated in all studies that gross margin and total expenses affect the net margin of the association.

Mather (6) stated in Kansas "larger net income in the high volume companies is due to a wider gross margin rather than lower expenses." "The expenses of delivery were about the same per gallon price." "Higher gross margins were apparently due to large companies' ability to avoid price wars."

Koller and Jesness (3) stated in Minnesota "the lowering of net income from 1938 to 1939 was due to an increase in operating expenses." This tendency seems to be showing up in the present time; gross margins have not been changed and are not influenced by the individual cooperatives in their area, and the net income ratio to sales has been decreasing with margins remaining about the same and the expenses ratio rising. This indicates that a closer study of expenses and the general policies of the association are necessary in order to remain in business.

Another factor influencing the success of a cooperative is the percent of member equity invested in other cooperatives.

Manning and Koller (5) stated in Minnesota "petroleum associations led with investments in other cooperatives, $25,959 (average for the group), nearly double the average of any other type." "These investments were largely the result of patronage refunds distributed by the regionals, book credits in reserves, and capital stock." The average total member equity was $73,454 and the average investment in other cooperatives was $25,959. This is better than one-third of the member equity invested in other cooperatives.

SCOPE AND METHOD

The goal of this study was to develop objective guides to answer problems of economic efficiency of individual petroleum cooperative associations.

The empirical data used in this study were taken from operating statements and balance sheets of 149 cooperative petroleum associations located in six midwestern states. These data were obtained from the Consumers Cooperative Association's Auditing and Business Analysis Report (CCA Report), for the fiscal year of 1952-1953. The CCA Report is used for several reasons: first, this was the largest number of similar records available and size of sample is important in statistical methods; second, cooperatives were located in the midwestern states; third, cooperatives were patronizing the same wholesale regional; fourth, records of all cooperatives were analyzed in the same method because they were analyzed by one auditing group.

The scope of this study covers the area of the individual firm and its economic operations for the fiscal year 1952-1953. It is the decision of the local firm as to the dates of the fiscal year, therefore, all of the fiscal years end in the latter part of 1952 and the early part of 1953 and are considered to be covering essentially the same period. This year was not a year of depression, inflation or a year of war shortages. It was chosen because it was not radically different than an average year. It must be kept in mind by the reader that the conclusions reached in this study are based on one fiscal year's data and care should be taken in applying the results of this study to other years. The study excludes patronage refunds from regionals because the efficiency of the firm itself is the essence of this study. This study includes only firms which are considered cooperative retail petroleum associations. The firm is an individual cooperative retail petroleum association when it meets two requirements: first, it must be an association established with cooperative principles as a local retail purchasing firm; second, fifty percent or more of the firm's sales must be composed of petroleum and related products.

The method used in this study was the compiling of the actual information from the individual cooperatives' balance sheets and operating statements. This information was then analyzed by use of statistical tools to determine the effectiveness of the individual firms in attaining economic goals. The level of significance for the statistical results is the 10 percent level.

ANALYSIS OF ECONOMIC FACTORS RELATIVE TO SUCCESS

Success is defined as a favorable termination of a venture. There are a number of economic factors relative to success. This study was concerned with an analysis of those economic factors for which information was contained in balance sheets and operating statements. This study was limited because of other economic factors (manager's ability, management practices, organization and member loyalty) which cannot be measured from the balance sheet or operating statement.

Measuring Degree of Success

Measuring degree of success was the first problem encountered. Degree of success was measured in this study by using an effectiveness index. Effectiveness was defined as attaining desired economic goals. In this study then an effectiveness index number was the firm's degree of effectiveness in attaining its economic goal.

In this study the economic goal was defined as the profitability of the firm to its members. To measure this goal two ratios which are commonly used by all types of businesses to reflect the firm's relative profitability were used. These two measures were: percent operating savings is of sales, hereafter to be called rate of savings; and percent operating savings is of member equity (net worth), hereafter to be called rate of return. Operating savings are defined as the total gross margin minus both total expenses and patronage refunds from regionals. Operating savings thus reflects only the income received by the cooperative at the local level.

The effectiveness index was based upon the following assumptions:

1. A cooperative's goal of maximizing profits was assumed to maximize the member's return, therefore, it was assumed that rate of savings made in the cooperatives is a measure of profitableness.

2. Rate of return on investment in a cooperative was assumed to correspond to the view the member takes of a similar investment in his farming enterprise, therefore, rate of return was assumed to be a measure of profitableness.

3. Management and other economic factors affecting success, that cannot be measured from the balance sheet or operating statement, are considered random variables for this analysis.

4. Cooperatives in this study were assumed to have purchased their goods from the same wholesale firm, therefore, the costs of procurement of goods sold were assumed to be the same for all firms.

The effectiveness index was used to measure the varying degrees of effectiveness of the different firms in attaining their economic goal. This index was based on a combination of rate of savings and rate of return ratios. A combination of the two ratios was considered to give a more accurate measure of effectiveness than either one alone. The combination modified the erratic differences in the two ratios. The combining of the two ratios with equal weight was purely an arbitrary decision. There was no apparent reason for combining them in any other way. Using either rate of savings or rate of return alone as an index would give slightly different specific results but would not change the general conclusions of the study.

More specific results pertaining to this data might be obtained if the data were divided into two groups (effective and ineffective). In order to divide the data into two groups it was necessary to select a level in the effectiveness index at which the firm was considered to be effective. This level was purely an arbitrary decision. The level selected would make no difference in the general conclusions but would help define the specific results. The level used in this study was the medians of the two ratios. This level was used because it was convenient. Those associations having a combined rate of savings and rate of return above the medians of the two ratios were considered effective in attaining their economic goal and those below the medians of the two ratios were considered ineffective in attainment of their economic goal. It is necessary that the reader accept this arbitrary level of effectiveness in order for the specific conclusions to be valid.

The reader should keep in mind that the arbitrary level of effectiveness pertains specifically to the data used in this study and care should be taken in applying the results to other data. The general conclusions of the study are not affected by the arbitrary decisions made in measuring the degree of success.

Rate of return and rate of savings were arrayed separately and medians were found. The median in each array was given an index number of 100 and all other rates are given corresponding indexes. This computation yielded a single index number for rate of savings and rate of return for each cooperative. The two indexes were added together for each firm and then divided by two. The result was an effectiveness index for each individual cooperative.

The median for rate of savings was 2.82 percent of sales. There were $2.82 of savings for every $100 sales. This rate of savings was given an index number of 100. The median for rate of return was 11.19 percent of member equity. For every $100 of investment there was $11.19 return. This rate of return was given the index number of 100. As an example a firm having a rate of savings of 2 percent and a rate of return of 15 percent would have an index of 70.9 for rate of savings and 134.0 for rate of return. The effectiveness index would be 70.9 plus 134.0 divided by two or 205.9 divided by two which would be 102.95. An effectiveness index was found for each individual cooperative in this manner.

If an individual cooperative has an effectiveness index of 100 or more, it was considered effective. If the effectiveness index was below 100, the cooperative was considered ineffective. A cooperative having an effectiveness index of 120 would be effective and a cooperative having an effectiveness index of 60 would be ineffective. A frequency distribution of associations according to their effectiveness indexes is shown in Table 1.

Table 1. Frequency distribution of 149 Midwestern petroleum associations by effectiveness index, 1952-53.

Effectiveness index	Number of associations
400 and over	3
300 to 399	9
200 to 299	18
100 to 199	50
0 to 99	40
-99 to 0	0
-199 to -100	12
-299 to -200	4
-399 to -300	4
Over -400	9
Total	149

Selection of the Variables that Influence Degree of Success

The variables to be studied were selected in the following ways: suggestions of cooperative advisors, observation and study of the data, and general knowledge.

It is thought that the advisors in the petroleum cooperative industry believe that size of business and extension of credit have influence on the success of a petroleum cooperative.

By observation and study of the data the investment in the local cooperative was chosen as a variable which would influence success.

General observation and knowledge suggests that gross margin would have a positive relation to success and that total expenses would have an inverse relationship to success.

Extension of Credit

Extension of credit in cooperatives has been discussed by cooperative leaders for a number of years. The so-called principle, cash trading, has been used increasingly less in the past few years because of the retail competition which a cooperative faces. The nature of the farm customer's business requires credit because of its seasonal returns and because of rising costs of the farming industry. The cooperative's competitors and the nature of cooperative's customer's business has caused the majority of retail cooperatives to extend credit. What effect does the amount of credit extension have on the success of cooperatives? The purpose of this study was to take an objective look at extension of credit in cooperatives to determine what has actually happened in the extension of credit and what was its effect upon success.

Measuring Credit Extension. The data used were taken from the balance sheets and operating statements of 149 retail petroleum cooperatives of six midwestern states for the 1952-53 fiscal year. Days of sales in accounts receivable were used as the measure of extension of credit.[1] Days of sales in accounts receivable were computed for each firm by taking the total sales of the year and dividing it by 365 days. This gives the average sales per day. This figure was then divided into the accounts receivable figure in the cooperative's balance sheet at the end of the fiscal year. The figure obtained was days of sales in accounts receivable. An example of this might be, a firm with total sales of $365,000, divided by 365 days in a year would give $1,000 sales as the average day's business. The accounts receivable figure is $40,000. This figure divided by the average day's sales of $1,000 would give 40 days of sales in accounts receivable. The number of days of sales in accounts receivable, hereafter to be called days of sales, in this data had a range of zero days of sales to 60.7 days of sales. A frequency distribution of associations according to days of sales in accounts receivable is shown in Table 2.

Analysis of All Associations. Analysis of all associations (149) was done by use of simple linear regression analysis. A simple linear regression relationship between days of sales and effectiveness index gave a regression coefficient of -1.55 with a probability of more than .40. The null hypothesis

---

[1] Accounts receivable in this study are defined as the open accounts on the books at the end of the fiscal year that ordinarily draw no interest and are held by the firm without security or collateral.

Table 2. Frequency distribution of 149 Midwestern petroleum associations by days of sales in accounts receivable, 1952-53.

Days of sales in accounts receivable	Number of associations
0 - 6.9	16
7 - 13.9	38
14 - 20.9	26
21 - 27.9	31
28 - 34.9	22
35 - 41.9	12
42 - 48.9	2
49 - 55.9	1
56 - 62.9	1
Total	149

was accepted. The regression statistics are shown in Table 3. A simple linear regression line is shown in Fig. 1. In accepting the null hypothesis the regression coefficient was considered not to be significantly different from zero.

There was no significant relation between extension of credit and effectiveness. This means that within the limits of the data used the extension of credit did not influence the effectiveness.

Table 3. Simple linear regression statistics for 149 Midwestern petroleum associations, 1952-53.

Extension of credit (Y) related to:	Regression coefficient		Correlation coefficient		Constant
	b	P	r	P	a
Effectiveness index (X)	-1.55	$> .40$	.0624	$> .05$	71.7
Total expenses (X)	.0687	$< .001$	.262	$< .01$	15.08
Gross margin (X)	.0795	$< .001$	.262	$< .01$	16.07

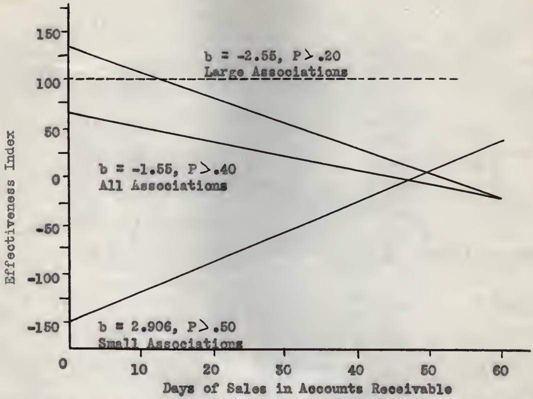

Fig. 1. Relation of days of sales in accounts receivable (X) and effectiveness index (Y) by size groups for 149 Midwestern petroleum associations, 1952-53.

As will be shown later in the text the two main economic factors influencing effectiveness in this study were gross margin and total expenses. There was evidence that the relation between extension of credit and effectiveness might be explained by these two factors. A simple linear regression relationship was computed with each of these two factors as to the influence that extension of credit had on them. The regression coefficient for gross margin was .0795 with a probability of less than .001. The regression coefficient for total expenses was .0687 with a probability of less than .001. The null hypothesis was rejected in both cases. Regression statistics are shown in Table 3. Linear regression lines are shown in Fig. 2. From observation of the regression lines and the regression coefficients it was apparent that

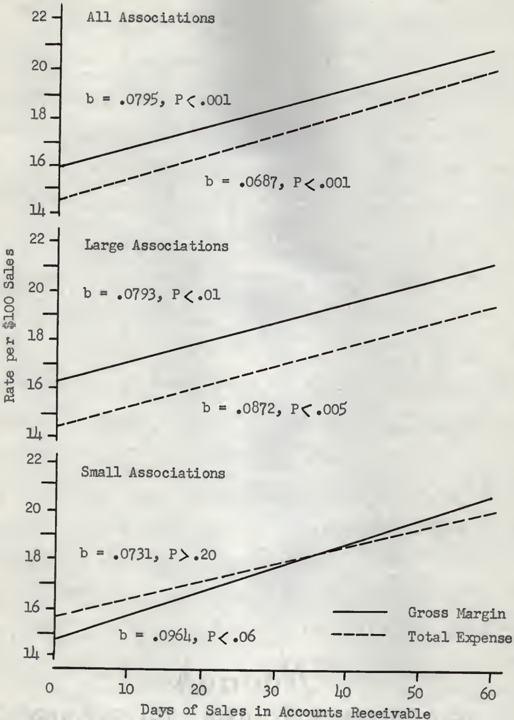

Fig. 2. Relation of days of sales in accounts receivable (X) and gross margin (Y) and total expenses (Y) by size groups for 149 Midwestern petroleum associations, 1952-53.

as days of sales increase gross margin rises faster than total expenses. This would indicate a surplus of gross margin over expenses and suggest that the effectiveness index should rise. As is seen in Fig. 1 the regression line for the 149 associations has a negative slope. The surplus of gross margin apparently does not have enough weight to offset other factors that influence effectiveness.

The opinion of many cooperative leaders has been that extension of credit was a detriment to effectiveness. This evidence presented would seem to offer a different opinion. The result of the information found by the study of the 149 associations would be that the extension of credit does not seem to affect effectiveness.

The 149 associations were broken into two size groups, under $100,000 and over $100,000 sales. The small size group was made up of 39 associations and the large size group had 110 associations.

Analysis of Small Associations. A simple linear regression was run with the small group between the effectiveness index and days of sales. The regression coefficient was 2.9 with a probability of greater than .50. The null hypothesis was accepted. Regression statistics are found in Table 4.

Table 4. Simple linear regression statistics for 39 Midwestern petroleum associations, having less than $100,000 sales, 1952-53.

Extension of credit (Y) related to:	Regression coefficient		Correlation coefficient		Constant
	b	P	r	P	a
Effectiveness index (X)	2.906	$>.50$	.1126	$>.05$	-145.74
Total expenses (X)	.0731	$>.20$	.2083	$>.05$	15.70
Gross margin (X)	.0964	$<.10$	.3139	$<.05$	14.73

A linear regression line is shown for the small group in Fig. 1. Although the regression coefficient was not significant, the regression line has a positive slope. This slope might be explained by the relationship of gross margin with extension of credit and total expenses with extension of credit. The regression coefficient for gross margin was .0964 with a probability of .05. The null hypothesis was rejected. The regression coefficient for total expenses was .0731 with a probability of more than .20. The null hypothesis was accepted. Acceptance of the null hypothesis in the total expenses relationship means that the regression coefficient would not be significantly different from zero. By comparing the gross margin coefficient with the total expenses coefficient there would be a surplus of gross margin. This would tend to give the effectiveness index relationship a positive slope. Because of the non-significant relationship between total expenses and extension of credit, the positive slope of the effectiveness index would be accentuated. Simple regression lines for the gross margin and total expense relationships with extension of credit are shown in Figure 2.

It can be seen in the evidence above that gross margin would rise and total expenses would not be likely to change as extension of credit was increased. There would not be any tendency of the effectiveness index to fall with this evidence. However, the relationship of effectiveness and extension of credit was not significant and would suggest that extension of credit would not cause the effectiveness index to vary in this small group.

Analysis of Large Associations. A simple linear regression was computed with the large group between the effectiveness index and days of sales. The regression coefficient was -2.55 with a probability of more than .40. The null hypothesis was accepted. Regression statistics are found in Table 5. A simple regression line is shown in Fig. 1. Slope of the regression line was negative. This slope might be explained by the relationship of gross margin and total expenses to the extension of credit. A simple regression relationship was computed for gross margin and for total expenses in relation to extension of credit. The regression coefficient for gross margin was .0793 with a probability of .01. The null hypothesis was rejected. The regression coefficient for total expenses was .0872 with a probability of .005. The null hypothesis was rejected. Simple regression lines may be seen in Fig. 2. As was seen in the regression coefficients and the regression lines total expenses rise faster than gross margin. This would give a surplus of expenses over margin and would indicate a negative slope in the relation of effectiveness to extension of credit.

Table 5. Simple linear regression statistics for 110 Midwestern petroleum associations, having more than $100,000 sales, 1952-53.

Extension of credit (Y) related to:	Regression coefficient		Correlation coefficient		Constant
	b	P	r	P	a
Effectiveness index (X)	-2.55	>.40	-.1132	>.05	133.56
Total expenses (X)	.0872	<.005	.2783	<.01	14.48
Gross margin (X)	.0793	<.01	.2643	<.01	16.41

To summarize the results in the large group, non-significance of the relation of effectiveness to extension of credit indicates that as credit was extended the effectiveness index did not change.

Summary and Conclusions. In summarizing extension of credit and its relation to the effectiveness index, the conclusion of this section was that the slope of the regression lines of the different size groups and the rate of slope of the regression lines in the relation of gross margin and total expenses to extension of credit were an indication of the amount of carefulness with which a firm should regulate its credit policy. The small group could be a little more lenient with its credit policy than the large group. The conclusion of this study was that the extension of credit, within the limits of this study, does not cause a variance in the effectiveness index, that is, that as credit was extended the effectiveness index does not change. To check the possibility of these results being applicable only to a particular situation, other data were compared in the same way for a different year with even more marked results.[1]

The conclusions of this section are not along the same line of thinking as opinions of some cooperative leaders or as conclusions of other studies made of credit. The results of this section were considered to be of such significance as to warrant a special section. The including of these results was not to infer that a thorough study of credit was made. Study of credit was limited only by limitations of the data. The conclusions, however, should be helpful to future studies of credit.

Size of Business

What is the effect of size of business on the effectiveness of a petroleum cooperative? Are economies of scale evident? These questions define the problem approached in this section.

---

[1] The extension of credit analysis as done with 48 Kansas petroleum associations, 1955 data, is discussed in Appendix 1.

Measuring Size of Business. Size of business was measured by total sales. Total sales are defined as the cost of goods sold plus the margin on the goods sold. The figure of total sales was taken from the cooperative's operating statement. Size of business was quoted in $1,000 of sales in this study. As an example, to describe a business having $162,498 of sales: the figure used in the text would be $162.5 of sales.

The 149 petroleum cooperatives had a range in size of business from $23.6 to $1,236.0. A frequency distribution for these cooperatives is shown in Table 6.

Table 6. Frequency distribution of 149 Midwestern petroleum associations by size of business, 1952-53.

Size of business ($1,000 sales)	Number of associations
0 - 49.9	11
50 - 99.9	28
100 - 149.9	38
150 - 199.9	25
200 - 249.9	11
250 - 299.9	10
300 - 349.9	7
350 - 399.9	5
400 - 449.9	6
450 - 499.9	2
500 or over	6
Total	149

Simple Linear Regression Analysis. Simple linear regression expresses a relation between a dependent variable and one independent variable ($Y = F\ (X_1/X_2 \ldots X_n)$). Size was measured in $1,000 of sales and effectiveness was measured by the effectiveness index derived for each cooperative.

The regression coefficient for this relationship was .292 with a probability of less than .05. The null hypothesis was rejected. Statistical data are found in Table 7. This regression coefficient of .292 would indicate that as sales increased $1,000 the effectiveness index would increase .292. To obtain an effectiveness index of 100 the firm would need $398,904 of sales. This is shown graphically in Fig. 3. The algebraic equation shown below was used.

The algebraic equation was $Y = a + bX$. Y was the dependent variable effectiveness index. X was the independent variable sales in $1,000. a was the constant ($a = \bar{Y} - b\bar{X}$). b was the regression coefficient. Effectiveness index of 100 was desired. b was .292 and a was -16.48. $398.9 sales was necessary to obtain an effectiveness index of 100.

This simple linear regression relationship was significant at less than .10 percent level, which was the level of significance used in this study. The relationship shows that there was some relation between size and effectiveness index, but it indicates that size had a very small influence.

Table 7. Simple linear regression statistics for 149 Midwestern petroleum associations, 1952-53.

Effectiveness index: (Y) related to:	Regression coefficient: b	P	Correlation coefficient: r	P	Constant a
Sales (X)	.292	<.05	.169	<.05	-16.48
Gross margin (X)	31.66	<.001	.388	<.01	-518.58
Total expenses (X)	-39.68	<.001	-.395	<.01	529.37
Investment in local co-op (X)	7.97	<.001	.505	<.01	-431.44

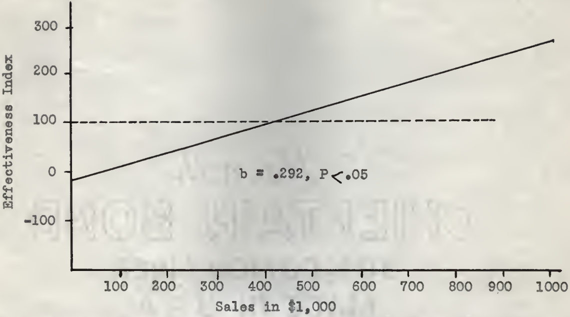

Fig. 3. Relation between size of business (X) and effectiveness index (Y) for 149 Midwestern petroleum associations, 1952-53.

Multiple Regression Analysis. Simple linear regression is limited in its assumption that only one independent variable affects the dependent variable. Multiple regression does not have this limitation and is generally considered by statisticians a more complete measure of a relationship. Multiple regression expresses the relation between a dependent variable and a number of independent variables. The generally accepted equation is $Y = F (X_1, X_2, X_3, X_4/X_5..X_n)$. Multiple regression measures an interrelated effect of a number of independent variables on a dependent variable. The net effect of an independent variable on the dependent variable may be approximated by varying a given independent variable and holding the other independent variables constant at their averages. This nullifies the limitation caused by use of simple linear regression because it measures the influence on the dependent variable of a given independent variable plus the added influence of the other independent variables.

The purpose of this section was to determine if size has an influence on effectiveness. Simple linear regression analysis suggested that there was such a relationship. Simple linear regression relationships were calculated for a number of other variables to determine if they influenced effectiveness. The results were that three other variables, gross margin on sales, total expenses and percent of member equity invested in the local cooperative were found to influence effectiveness. These variables were then included as variables in the multiple regression equation. They will be discussed individually later in the text.

The specific multiple regression equation used was (effectiveness index was a function of gross margin, total expenses, size of business and investment in local cooperatives). This equation expressed algebraically was $EI = F\ (X_G, X_E, X_S, X_I)$. Statistical results of this equation are shown in Table 8.

Table 8. Multiple regression statistics for 149 Midwestern petroleum associations, 1952-53.

Effectiveness index (EI) related to:	Regression coefficients			Average	Partial correlation coefficients
	B	t	P	$\tilde{x}$	
Gross margin (X_G)	45.457	8.458	$<.001$	17.66	.557
Total expenses (X_E)	-43.867	-9.106	$<.001$	16.47	-.583
Sales (X_S)	- .000819	-.008	$>.90$	195.20	-.00047
Investment in local co-op (X_I)	3.96	4.177	$<.001$	59.22	.251

$R = .7568$, $R^2 = .5627$, d.f. 4 and 144, $F = 48.26$, $a = -273.98$

The result of the computations gave the regression coefficient for size as -.000819 with a probability of more than .50. This means that the regression coefficient was not significantly different from zero and that the effectiveness index was not influenced either way, plus or minus, by size of business.

Chi Square Analysis. The statistical tool of chi square was used to determine the variation from an accepted standard or hypothesis. In this study it was used to determine if there was any variation in chances of an association being effective as the size of a business changes.

The data used in setting up the effectiveness index was based on the medians of the two arrays of rate of savings and rate of return. The standard or hypothesis was assumed to be a 1:1 ratio or a 50-50 chance of being effective. Table 9 shows the chi square results. The pooled chi square (or all associations) has a chi square of .328 with a probability of more than .50 of getting a larger chi square if the hypothesis (H_0) was true. Hypothesis of 1:1 ratio was accepted.

The data were divided into three size groups. Size groups were (under $100,000 sales, $100,000 to $200,000 sales and over $200,000 sales). Chi squares for the under $100,000 and $100,000 to $200,000 size groups were found to be 1.254 and .397 respectively, with a probability of greater than .10 of obtaining a larger chi square if H_0 were true. H_0 was accepted in these two groups. Chi square results are shown in Table 9. The over $200,000 sales group had a chi square of 1.68 with a probability of less than .01 of getting a larger chi square if H_0 were true. In this case the H_0 of 1:1 ratio was rejected. The large size group has a ratio significantly different from the hypothesis 1:1 ratio. Another check of homogeneity of the data was

Table 9. 149 Midwestern petroleum associations classified as effective or ineffective, by size groups, with chi square statistics, 1952-53.

Size groups ($1,000 sales)	Number of associations			Expected number[a]		Chi square		
	Effective	Ineffective	Total	Effective	Ineffective	χ^2	P	Confidence intervals CI_{99}
Under $100.0	16	23	39	19.5	19.5	1.254	$>.10$	23.6-64.7
$100.0 to $200.0	29	34	63	31.5	31.5	.397	$>.50$	33.5-67.16
Over $200.0	33	14	47	23.5	23.5	7.68	$<.01$	49.4-84.5
Pooled	78	71	149	74.5	74.5	.328	$>.50$	39.5-64.5

Contingency chi square = 9.026 with 2d.f., $P < .025$.

[a] The expected hypothesis is a 1:1 ratio.

the use of contingency chi-square. H_0 for a contingency chi square was the total of effective associations against the total of ineffective associations. H_0 was 52 percent of the associations were effective and 48 percent were ineffective. Contingency chi square was 9.026 with a probability of .025 that a larger chi square could be obtained if H_0 were true. H_0 was rejected and the data were not considered to be homogeneous. The contingency chi square result above suggests that there were different ratios in the data. Use of confidence intervals throw more light on the difference of ratios. Using an interval of probability of 0.99 it was expected, allowing for sampling error, about 99 of the intervals out of 100 would contain the true percentage. It is noticed in Table 9 that with a confidence interval of 0.99 (CI_{99}) the true percentage for the small group would lie between 23.6 and 64.75. The true percentage for the large group would lie between 49.4 and 84.5. By observation it was apparent that the ratio for effective associations would have more chance of being above 50 percent in the larger size group than it would in the smaller size group. Similar information and results were obtained from data of different years.[1]

Relation to Gross Margin and Total Expenses. Gross margin was the difference between cost of goods sold and total sales. Gross margin was expressed in this study as percent of sales. Total expenses was the difference between the total (of gross margin plus other savings) minus the total (of operating savings plus patronage refunds from regionals plus other income). Total expenses are all variable expenses and fixed expenses incurred during a fiscal year. Total expenses were expressed in the text as percent of sales.

---

[1] The use of chi square for testing the chances of effectiveness in relation to size groups was done with data from the years 1951-52 and 1955. The results are shown in Appendix 2.

Simple regression relationship was computed for size of business and gross margin. The regression coefficient was .00249 with a probability of more than .10. The null hypothesis was accepted. Regression statistics are shown in Table 10. This result indicates that there was no significant relation between gross margin and size of business.

Table 10. Simple linear regression statistics of gross margin and total expenses in relation to size for 149 Midwestern petroleum associations, 1952-53.

Sized business (X) related to:	Regression coefficient b	Regression coefficient P	Correlation coefficient r	Correlation coefficient P	Constant a
Gross margin (Y)	.00249	$>.10$	.118	$>.05$	17.17
Total expenses (Y)	-.00288	$>.10$	-.125	$>.05$	17.03

A simple linear regression relationship was computed for total expenses and size of business. The regression coefficient was -.0028 with a probability of more than .10. The null hypothesis was accepted. There was no significant relation between total expenses and size of business.

Economies or diseconomies of scale are apparent in industries where there is a significant relation between size and gross margin or size and total expenses. It is probable there are neither economies or diseconomies of scale in these data or in the retail cooperative petroleum industry. Economies of scale are less evident in low fixed cost industries than they are in high fixed cost industries. Retail petroleum industry was considered in the low fixed cost category. There was variation in expenses and margins in these associations. This variation, however, was not due to size.

Summary and Conclusions. In summary, simple linear regression showed a significant relation between size and the effectiveness index, but the influence of size on the effectiveness index was small. By the use of multiple regression it was found that size had no significant relation with the effectiveness index when the influence of other variables was taken into account. Chi square suggested there was a difference in the ratios between effective and ineffective associations in different size groups. Chi square also indicated that associations of the large size group had a better chance for their true percentage of effective associations being greater than 50 percent. Simple regression relationships between size and gross margin and size and total expenses indicated that there was no significant relationship between size and gross margin and size and total expenses.

In conclusion it cannot be said that there was a relation between size and effectiveness. Nor can it be said that there was no relation between size and effectiveness. It is possible to say, however, that there seemed to be more chance of effectiveness in an association with more than $200,000 sales than there was in an association with less than $100,000 sales.

Investment in the Local Cooperative

Investment in the local cooperative was the total member equity minus investment in other cooperatives. Of the total investment in a local cooperative, does the amount invested in other cooperatives influence the effectiveness of an association in obtaining their economic goal? This information was taken from the firm's balance sheet. Investment in the local cooperative, hereafter called investment, was expressed in this study as a percent of the member equity. The investment in this data varied from 000.0 percent to 99.4 percent of the member equity. A frequency distribution of associations according to percent of investment is shown in Table 11.

Table 11. Frequency distribution of 149 Midwestern petroleum associations by percent investment in the local cooperative, 1952-53.

Percent of investment in local cooperative	Number of associations
0 - 9.9	6
10 - 19.9	2
20 - 29.9	1
30 - 39.9	8
40 - 49.9	11
50 - 59.9	30
60 - 69.9	61
70 - 79.9	20
80 - 89.9	6
90 - 99.9	4
Total	149

Simple Linear Regression Analysis. As was stated earlier, simple linear regression was used to determine the relation between the effectiveness index and investment. The regression coefficient was 7.97 with a probability of less than .001. The null hypothesis was rejected. Regression statistics are shown in Table 7. In Fig. 4 a simple linear regression line shows that in order to have an effectiveness index of 100, 66.68 percent of the member equity must be invested in the local cooperative. The algebraic equation was $Y = a + bx$; Y = effectiveness index, a was a constant -431.44 ($a = \overline{y} - b\overline{x}$) and the regression coefficient was 7.97.

There was a significant relation between investment and the effectiveness index. As the cooperative invests less of its member equity in the local cooperative the effectiveness index decreases.

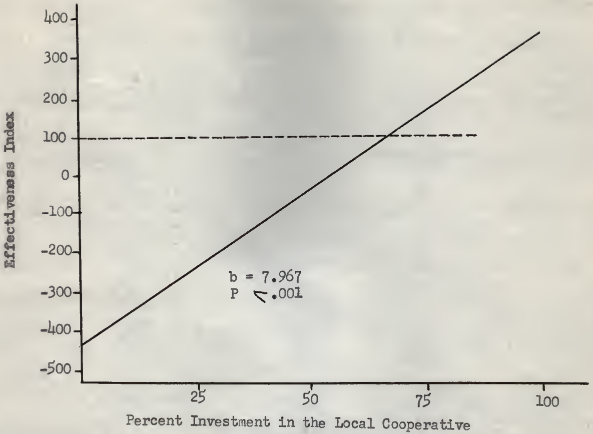

Fig. 4. Relation between investment in local cooperative (X) and effectiveness index (Y), for 149 Midwestern petroleum associations, 1952-53.

Multiple Regression Analysis. Investment was used as one of the independent variables in the specific multiple regression equation, $EI = X_G, X_E, X_S, X_I$. X_I was the independent variable investment. X_G was the independent variable gross margin. X_E was the independent variable total expenses. X_S was the independent variable size. EI was the dependent variable effectiveness index.

The regression coefficient of investment was 3.96 with a probability of less than .001. The null hypothesis was rejected. Multiple regression statistics are shown in Table 8.

It was possible to show the approximate relation between investment and the effectiveness index by varying investment and holding the other independent variables, X_G, X_E, and X_S, constant at their averages.

To obtain a success index of 100 the algebraic equation shown below was used.

$$a = -273.98$$

$$EI = a + bX_G + bX_E + bX_S + bX_I$$

$$100 = -273.98 + 45.46\ (17.66) + (-43.87)\ (16.47) + (-.000819)$$

$$(195.2) + 3.96X_I$$

$$3.96X_I = 295.26$$

$$X_I = 74.56$$

In order to obtain an effectiveness index of 100, 74.56 percent of member equity needs to be invested in the local cooperative. Figure 5 shows the regression line of investment in relation to effectiveness index when the other independent variables are taken into account.

Summary and Conclusions. The results of this section show a significant positive relation between effectiveness index in both linear regression and multiple regression relationships.

For the firm to have an effectiveness index of 100, it needs to have 74.56 percent or more of its member equity invested in the local cooperative. This suggests that as the local cooperative patronizes the regional on the assumption that the regional does not pay back the patronage refund, but holds it in a revolving fund or some similar type of investment for the local cooperative, the local cooperative must replenish its own member equity to keep the rate of investment in the local cooperative from decreasing the firm's chances for effectiveness.

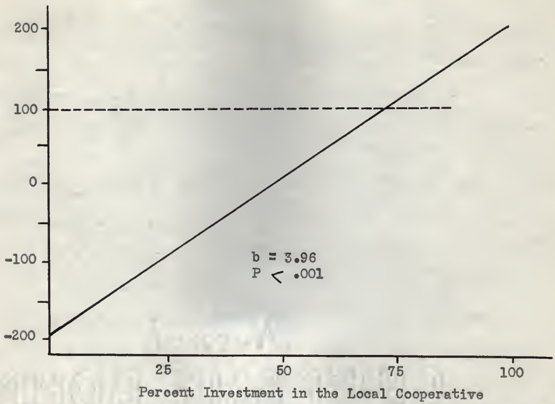

Fig. 5. Multiple regression relation between investment in local cooperative (X) and effectiveness index (EI), with X_G, X_E, and X_S held constant at their averages, for 149 Midwestern petroleum associations, 1952-53.

Other Factors Affecting Degree of Success

There are two other factors known to be influencing effectiveness. These are gross margin and total expenses. It was well known that these two factors would influence effectiveness. There are two reasons for using them in this study. First, was to measure their net effect on effectiveness. Secondly, was to use them in a multiple regression relationship to measure the influence of other variables on effectiveness.

Gross Margin. Gross margin was the total sales minus cost of goods sold. Gross margin was measured in percent of sales. The range of gross margin in this data was 9.23 to 26.83. A frequency distribution of associations according to gross margin is shown for the 149 associations in Table 12.

Table 12. Frequency distribution of 149 Midwestern petroleum associations by percent of gross margin, 1952-53.

Gross margin in percent of sales	Number of associations
9.0 - 10.9	4
11.0 - 12.9	12
13.0 - 14.9	16
15.0 - 16.9	33
17.0 - 18.9	31
19.0 - 20.9	29
21.0 - 22.9	13
23.0 - 24.9	7
25.0 - 26.9	4
Total	149

Simple linear regression analysis was used to determine if gross margin was influencing effectiveness. The regression coefficient was 31.66 with a probability of .001. The null hypothesis was rejected. Statistical data are shown in Table 7. In order for the firm to be effective an effectiveness index of 100 or more is necessary. The algebraic equation as follows was used.

$Y = a + bX$

Y = Effectiveness index (100)

a = constant (-518.58)

b = regression coefficient (31.66)

X = gross margin

The percentage of gross margin needed for an effectiveness index of 100 was 19.54. A simple regression line for this relationship is shown in Fig. 6.

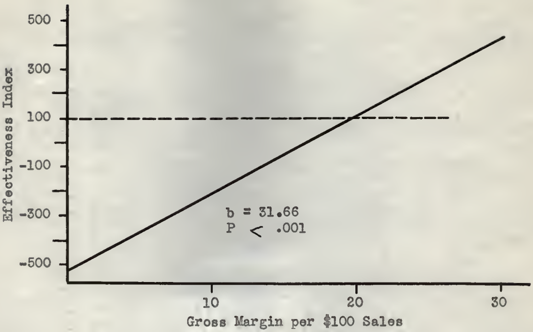

Fig. 6. Relation between gross margin (X) and effectiveness index (Y), for 149 Midwestern petroleum associations, 1952-53.

Multiple regression analysis was used to measure the net effect of gross margin on effectiveness index. The regression coefficient was 45.46 with a probability of less than .001. The null hypothesis was rejected. Statistical results are shown in Table 8. The specific algebraic equation used was $EI = a + bX_G + bX_E + bX_S + bX_I$. EI = effectiveness index (100), a = constant (-273.98), X_G = gross margin, X_E = total expenses, X_S = total sales, and X_I = investment in the local cooperative.

In order to obtain an effectiveness index of 100 or more, 19.0 percent or more gross margin was needed. A multiple regression line showing gross margin varied, and the other factors, X_E, X_S, and X_I, held constant at their averages, is shown in Fig. 7. The 19.0 percent gross margin needed for an effectiveness index of 100 might be called a standard for these data.

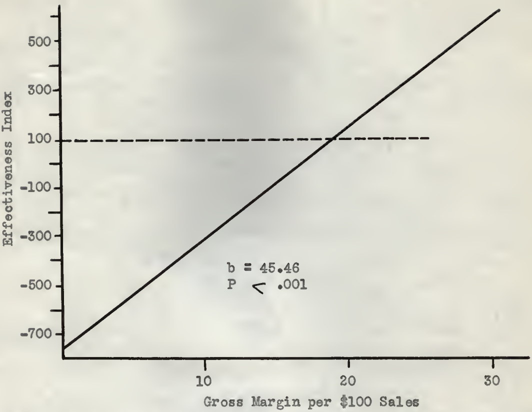

Fig. 7. Multiple regression relation between gross margin (X_G) and effectiveness index (EI), with X_E, X_S, and X_I held constant at their averages, for 149 Midwestern petroleum associations, 1952-53.

Total Expenses. Total expenses are the total of the fixed and variable expenses incurred during a fiscal year. The total expenses for the 149 associations had a range of 6.45 to 28.96 per cent total expenses. Total expenses are expressed as percent of sales. A frequency distribution of associations according to total expenses is shown in Table 13.

Simple linear regression analysis was used to determine the effect of total expenses on the effectiveness index. The regression coefficient was -29.68 with a probability of less than .001. The null hypothesis was rejected. Statistical information obtained is shown in Table 7. The firm

Table 13. Frequency distribution of 149 Midwestern petroleum associations by percent of total expenses, 1952-53.

Total expenses in percent of sales	Number of associations
6 - 8.9	3
9 - 11.9	15
12 - 14.9	36
15 - 17.9	49
18 - 20.9	30
21 - 23.9	10
24 - 26.9	5
27 - 29.9	1
Total	149

must have an effectiveness index of 100 in order to be effective. The algebraic equation as follows was used.

$Y = a + bX$, Y = effectiveness index (100), a = constant (529.37) and X is total expenses

The percentage of total expenses would need to be 14.47 or less if the effectiveness index was to be 100 or more. A simple regression line is shown in Fig. 8.

Multiple regression analysis was used to determine the net effect of total expenses on the effectiveness index when X_G, X_S and X_I are taken into account. The multiple regression coefficient for total expenses was -43.87 with a probability of less than .001. The null hypothesis was rejected. Statistical results are shown in Table 8. A multiple regression line is shown in Fig. 9. The firm must have an effectiveness index of 100 in order to be effective. The algebraic equation that follows was used.

$EI = a + bX_G + bX_E + bX_S + bX_I$ EI = effectiveness index (100) and a = constant (-273.98)

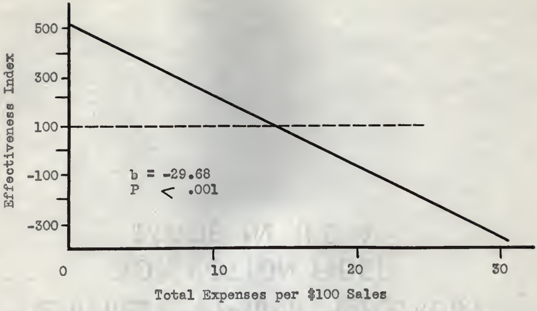

Fig. 8. Relation between total expenses (X) and effectiveness index (Y), for 149 Midwestern petroleum associations, 1952-53.

The percentage of total expenses needed for an effectiveness index of 100 or more was 15.09 or less. This might be used as a standard for effectiveness, in this study.

Summary and Conclusions. In summary the total expenses and gross margin both have significant relationships with the effectiveness index. Their net effect was measured by the regression coefficients from multiple regression analysis. They are 45.46 for gross margin and -43.87 for total expenses. The percentages needed for an effectiveness index of 100 or more are 19.0 or more for gross margin and 15.09 or less for total expenses.

It was the conclusion of this section that total expenses and gross margin have an influence on effectiveness; that their influence on the effectiveness index increases if multiple regression analysis was used; that the percentages 19.0 for gross margin and 15.09 for total expenses might be used as standards of effectiveness for this data.

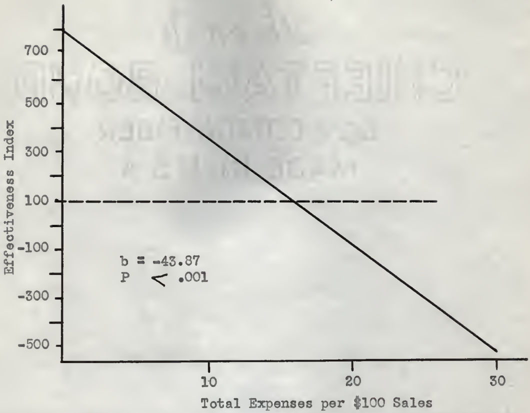

Fig. 9. Multiple regression relation between total expenses (X) and effectiveness index (EI) with X_G, X_S, and X_I held constant at their averages for 149 Midwestern petroleum associations, 1952-53.

SUMMARY AND CONCLUSIONS

An effectiveness index was computed for each of 149 individual petroleum cooperatives as a measure of economic efficiency. The index was computed by arraying rate of savings and rate of return and giving to the medians of each an index number of 100. All other rates were ranked with the medians. The two indexes then were averaged. The result gave an effectiveness index for each cooperative. An effectiveness index of 100 or more would be considered an effective association.

The variables used in the study as influencing the effectiveness of a petroleum cooperative were selected by suggestions of cooperative advisers, by general observation and knowledge, and by examination of the data. The variables selected to be studied were extension of credit, size of business, investment in the local cooperative, gross margin, and total expenses.

Simple linear regression analysis was used to determine the influence that extension of credit had on the effectiveness of a petroleum cooperative. It was found that there was no significant relationship between days of sales and the effectiveness index for the 149 associations. The 149 associations were divided into small and large groups as to dollars of sales. The relation of effectiveness index and extension of credit was not significant for either the small or large group. The slope of the regression lines, although they were not significant, might be explained by the relation of the gross margin and the relation of the total expenses with extension of credit. When the slope of the regression line for the relation of effectiveness and extension of credit was positive, there was a surplus of gross margin over expenses for that group of associations. The result for a negatively sloped line was a surplus of expenses over gross margin. The small group had a positively sloped line and the large group and the 149 associations had a negatively sloped line.

The conclusion of this section was that the large size associations would need to be more careful of their extension of credit than the small size group because of the negative slope of the regression line indicated in the effectiveness index -- days of sales relationship. Also, as the amount of credit extension was increased the effectiveness index was not affected.

Simple linear regression analysis was used to determine the variables influencing the effectiveness of an association. Size of business in total sales was the first variable selected. In simple regression the size of business had a significant relation to effectiveness index, although this effect was small -- a change of .292 in the effectiveness index for every $1,000 increase in sales. In order to have an effectiveness index of 100 the firm would have to have a total sales of $398,904.

Total expenses, gross margin and percent of member equity invested in the local cooperative were also found to have a significant relation with the effectiveness index.

A multiple regression function was formulated with these four independent variables to find the net effect on the effectiveness index by each variable.

The regression coefficient found for size was not significantly different from zero. This would suggest that size of business, when the influence of other independent variables are taken into account, had no significant effect on the effectiveness index.

Chi square analysis was used to determine whether there was any variation in the chances of effectiveness as the size of business varies. The data were set up with a 50-50 chance of effectiveness by use of the medians of rate of savings and rate of return. The data were divided into three size groups, under $100,000 of sales, $100,000 to $200,000 sales and over $200,000 sales. The large size group was found to be significantly different from the H_0 of 1:1 ratio. Contingency chi square was found to be significantly different from the H_0 of 1:1 ratio also. This would mean that there was some difference between the size groups in the percentages of effective associations. To determine where the true percentages would lie, below 50 percent or above 50 percent, the use of confidence intervals of 99 percent were used. Confidence interval of 99 percent would mean that there would be 99 chances out of 100 that the confidence interval obtained would include the true percentage. The interval for the small group was 23.6 percent to 64.75 percent and the interval for the large group was 49.4 percent to 84.5 percent. It would seem probable that the chances for the number of effective associations to be above 50 percent would be greater in the large size group than in the small size group.

A significant relation between size and gross margin and between size and total expenses would show any economies or diseconomies of scale. The simple regression coefficients for these two relationships were found not to be significantly different from zero. The findings of these relationships would express neither economies nor diseconomies of scale.

It cannot be said that there was no relation between size of business and effectiveness. Neither can it be said that there was a relationship between these variables. It can be said, however, that there seems to be a better chance of effectiveness in an association which had $200,000 sales or more than in one which had less than $100,000 sales.

The third variable discussed in this study was investment of member equity in the local cooperative. The regression coefficient for this variable was found to be significant and would have an influence on the effectiveness index. The regression coefficient was 3.96. By holding the three independent variables (gross margin, total expenses and size) constant at their average, and varying investment, it was possible to find a regression line showing what approximate influence investment had on the effectiveness index. To obtain an effectiveness index of 100 or more the firm would need 74.56 percent of its member equity invested in the local cooperative.

The other two factors used in the multiple regression function were gross margin and total expenses. These two factors were found to be significant and had the greatest influence on the effectiveness index. The regression coefficients were 45.46 for gross margin and -43.87 for total expenses. By varying the gross margin and holding the other three variables constant at their average in these data, the firm would need 19 percent or more gross margin in order to obtain an effectiveness index of 100 or more. By varying total expenses and holding the other three variables constant at their average with these data, the firm would need 15.09 percent or less total expenses to obtain an effectiveness index of 100 or more.

The percentages of the three independent variables, gross margin, total expenses and investment, needed to obtain an effectiveness index of 100 might be used as standards for an effective cooperative in this study.

The correlation coefficient of the multiple regression function was .757. This figure squared was .573. This means that these four independent variables explain approximately 57 percent of the variance in the effectiveness index.

ACKNOWLEDGMENT

The guidance and assistance given by Dr. Milton L. Manuel, Associate Professor, Agricultural Economics, Kansas State College, in the preparation of this thesis is gratefully acknowledged.

The suggestions and assistance of Dr. Arlin M. Feyerherm, Associate Professor, Mathematics, Dr. Leonard W. Schruben, Ruth Clifton and others of the Department of Economics and Sociology, Kansas State College, and the use of the facilities of the department which made this study possible were greatly appreciated.

REFERENCES

(1) Jenkins, Lewis P.
"The Operating Policies and Practices of Cooperative Purchasing Associations in Mississippi."
Miss. St. College Agric. Expt. Sta. Bul. 491, 38 p., June 1952.

(2) Knapp, Joseph G. and French M. Hyre
"Farmers Retail Petroleum Associations."
Farm Credit Admin. Coop. Research and Service Div., Washington, D.C., Cir. C-113, 20 p., June 1939.

(3) Koller, E. Fred and O. B. Jesness
"Minnesota Cooperative Oil Associations."
U. of Minn. Agric. Expt. Sta., Bul. 351, 58 p. 1941.

(4) Knudtson, Arvid C. and Fred E. Koller
"Accounts Receivable Credit in Minnesota Farm Supply Cooperatives."
U. of Minn. Agric. Expt. Sta., Bul. 430, 29 p., May 1955.

(5) Manning, T. W. and Fred E. Koller
"Minnesota Farm Supply Associations."
U. of Minn. Agric. Expt. Sta., Bul. 421, 39 p., June 1953.

(6) Mather, Warren
"An Analysis of Farmers' Cooperative Oil Companies in Kansas,"
Report No. 1. Kan. St. College of Agric. and App. Sc., Extension Service, Ext. M. Cir. 27, 25 p., October 1940.

(7) Teachout, H. R.
"Credit Discussed at Vermont Conference."
Feedstuffs, p. 68., April 21, 1956.

APPENDICES

CHILTON BOND
25% COTTON FIBER
MADE IN U.S.A.

APPENDIX 1

The information obtained from the data of the 48 Kansas petroleum associations, 1955, gave results similar to the 149, 1952-53 data used in the text. In all associations there was no significant relation between extension of credit and the effectiveness index. This was also true of the different size groups. There seemed to be no influence on the effectiveness index by the extension of credit in any of the groups. The verification of the results was similar to that in the text also. Gross margin and total expenses relationships with the extension of credit were evident but not pronounced enough to influence the effectiveness index. The regression coefficients for these data are presented in Tables 14, 15 and 16. Figure 10 shows simple regression lines for these relationships. By comparing the regression coefficient of gross margin and total expenses by their amount and significance, the slopes of the regression line between effectiveness index and extension of credit might be explained. The regression lines for the 48 associations and the small and large groups for the relation of effectiveness and extension of credit are shown in Fig. 11.

The result in this data are similar to the result in the text. As the amount of extension of credit was increased there was no significant change in the effectiveness index.

Table 14. Simple linear regression statistics for 48 Kansas petroleum associations, 1955.

Extension of credit (Y) related to:	Regression coefficient		Correlation coefficient		Constant
	b	P	r	P	a
Effectiveness index (X)	.546	>.50	.037	>.10	66.87
Gross margin (X)	.088	<.05	.201	<.05	16.86
Total expenses (X)	.116	<.01	.381	<.01	14.82

Table 15. Simple linear regression statistics for 22 Kansas petroleum associations having less than $100,000 sales, 1955.

Extension of credit (Y) related to:	Regression coefficient		Correlation coefficient		Constant
	b	P	r	P	a
Effectiveness index (X)	2.976	>.40	.191	>.10	-55.48
Gross margin (X)	.081	>.10	.315	>.10	15.71
Total expenses (X)	.103	<.001	.827	<.01	14.96

Table 16. Simple linear regression statistics for 26 Kansas petroleum associations having more than $100,000 sales, 1955.

Extension of credit (Y) related to:	Regression coefficient		Correlation coefficient		Constant
	b	P	r	P	a
Effectiveness index (X)	-1.75	>.50	-.13	>.10	170.39
Gross margin (X)	.13	<.10	.36	>.05	17.14
Total expenses (X)	.152	>.10	.31	>.05	14.27

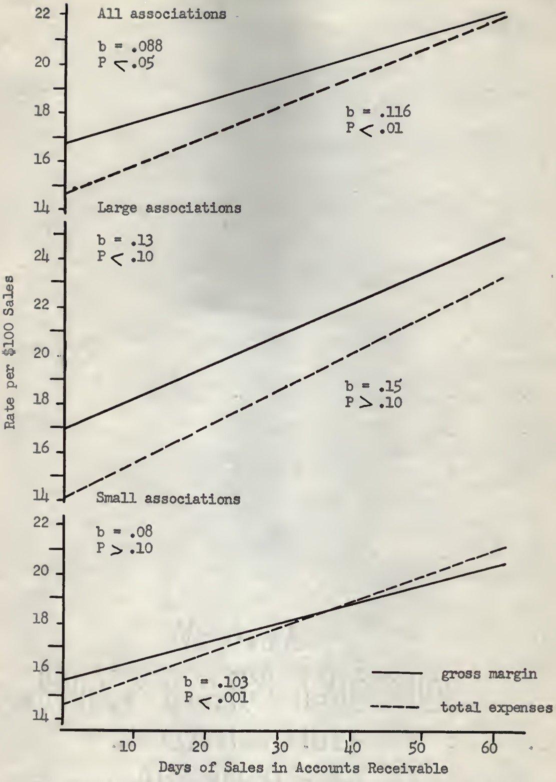

Fig. 10. The relation of days of sales in accounts receivable (X) and gross margin (Y) and total expenses (Y) by size groups for 48 Kansas petroleum associations, 1955.

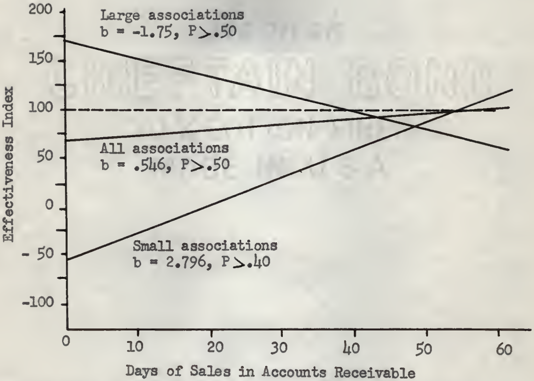

Fig. 11. Relation of days of sales in accounts receivable (X) and effectiveness index (Y) by size groups for 48 Kansas petroleum associations, 1955.

APPENDIX 2

The use of chi square as a statistical tool was made to determine if the data used for the text was a particular situation. This was done to determine if the data from the years 1951-52 and 1955 could be used to show the relations of size and effectiveness to substantiate the work in the text. The contingency chi square was the most powerful tool in this area to show if the data was all of the same population. In Table 17, the chi squares can be seen for each year and the pooled data for all three years. These chi squares are not significant at the .05 percent level. This indicates that the hypothesis of 1:1 would be accepted. The contingency chi square was .065 with two degrees of freedom, (P of getting a larger chi square than this if the hypothesis (1:1) was correct was more than .75). Acceptance of the hypothesis of 1:1 was in order and this indicates that the data was all from the same population.

The data from all three years was broken down as to size of sales. Three groups were used, under $100,000, $100,000 to $200,000, and over $200,000 of sales. An array of each year's effectiveness indexes was then set up and the associations having an effectiveness index of 100 or more were said to be effective and the others were considered ineffective. After this was completed for each year, the number of effective cooperatives was counted for each size group. Chi square was then computed for each size group, Table 18. Each size group had three years' data, 1951-52, 1952-53, and 1955. Pooled chi square (Table 18) for the total data was not significant at the .05 level. P of chi square being greater was more than .25 if the hypothesis (1:1 ratio) was correct. This indicates that in the overall view of all the data there was just a 50-50 chance of being effective.

Table 17. 339 Midwestern petroleum associations classified as effective or ineffective, by years, with chi square statistics, 1951-52, 1952-53, and 1955.

Years	Number of associations			Expected number[a]		Chi square		
	Effective	Ineffective	Total	Effective	Ineffective	χ^2	P	Confidence intervals CI_{99}
1951-52	69	63	132	66	66	.272	$>.50$	35.3-60.7
1952-53	78	71	149	74.5	74.5	.328	$>.50$	36.5-62.5
1955	26	22	48	24	24	.334	$>.50$	36.1-73.6
Pooled	173	156	329	164.5	164.5	.878	$>.25$	36.3-57.7

Contingency chi square = .063 with 2 d.f., $P > .75$

[a] The expected hypothesis is a 1:1 ratio.

Table 18. 339 Midwestern petroleum associations classified as effoctive or ineffective, by size groups, with chi square statistics, 1951-52, 1952-53, and 1955.

Size groups ($1,000 sales)	Number of associations: Effective	Number of associations: Ineffective	Number of associations: Total	Expected number[a]: Effective	Expected number[a]: Ineffective	Chi square: χ^2	Chi square: P	Chi square: Confidence interval CI_{99}
Under $100.0	39	61	100	50	50	4.84	$<.05$	27.0-52.0
$100.0 to $200.0	72	67	139	69.5	69.5	.18	$>.50$	35.4-60.6
Over $200.0	62	28	90	45	45	12.84	$<.005$	56.0-81.0
Pooled	173	156	329	164.5	164.5	.88	$>.25$	36.3-57.7

Contingency chi square = 17.085 with 2 d.f., $P < .005$

---

[a] The expected hypothesis is a 1:1 ratio.

Using chi square to determine if there was any difference in size groups (Table 18) led to the same conclusion as the text. The chi square for the under \$100,000 group was significant, P of chi square being larger was less than .05 if H_0 was correct. This leads to rejection of the H_0 and the assumption that the chances in the small group are not 50-50. The chi square for the over \$200,000 group was significant, P of chi square being larger was less than .005 if H_0 was correct. This leads to the rejection of the H_0 and the same assumption that was arrived at in the small group. Contingency chi square was also used to determine if the different size groups are of the same population. The contingency chi square was 17.085 with two degrees of freedom (Table 18), P of chi square being larger was less than .005 if H_0 was correct. This leads to the rejection of H_0 and the assumption that the different size groups were not of the same population.

To determine if this difference between size groups was pronounced enough to be substantial evidence, the use of chi square confidence intervals was made. The result was the use of 99 percent confidence intervals of chi square. The answer obtained was that there was no overlapping of the confidence intervals of the under \$100,000 and the over \$200,000 sales groups. The confidence interval for under \$100,000 was 27 to 52. This means that the chances of the confidence interval containing the true percentage are 99 out of 100. The confidence interval for the over \$200,000 sales group was 56 to 81 with the same probability as the small group. There was no overlapping of the confidence intervals as was seen above. This suggests that there was a difference between the large and small group and that this difference was that the larger group has a better chance of being effective than the small group.

ANALYSIS OF ECONOMIC FACTORS AFFECTING SUCCESS OF OPERATIONS OF SELECTED MIDWESTERN PETROLEUM COOPERATIVES

by

BYRON EUGENE TAYLOR

B. S., Kansas State College
of Agriculture and Applied Science, 1955

AN ABSTRACT OF
A THESIS

submitted in partial fulfillment of the
requirements for the degree

MASTER OF SCIENCE

Department of Economics and Sociology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1958

The success of a cooperative is influenced by both economic and non-economic factors. Economic factors, the concern of this study, may be grouped in two areas; (1) factors measured by data contained in operating statements and balance sheets, and (2) factors which cannot be analyzed easily since financial statements contain no measurement of them. The former are the factors discussed in this study.

Earlier studies of this subject have been made using comparative and factor analysis. This study was undertaken to help cooperative advisors in making sound future plans.

Two goals of cooperatives were assumed for the study: (1) farmer cooperatives attempt to maximize profits in order to maximize returns of members, and (2) cooperatives are a part of the member's farming enterprise.

The second group of economic factors were considered as random variables in this study. The non-economic factors were recognized as influencing the success of cooperatives, but were not considered in this study.

The purpose of this study was to determine what factors affect success of cooperative petroleum associations. Data were obtained from balance sheets and operating statements of 149 Midwestern petroleum associations for the fiscal year 1952-1953. Statistical techniques were used to determine effectiveness of the firms in attaining economic goals. The 10 percent level of significance was used. Patronage refunds from regionals were excluded because the efficiency of the firm itself was the essence of this study.

An effectiveness index was computed for each firm to measure the degree of success. This index was composed of two measures of profitableness; (1) the percent operating savings was of sales (rate of savings) and (2) the percent operating savings was of member equity (rate of return). All firms procured their goods from the same wholesale firm, therefore, the cost of goods sold was assumed to be the same for all firms.

The associations were classified into two groups according to their effectiveness index. Those having an index of 100 or more were considered effective in attaining their economic goal and those having an index below 100 were considered ineffective. Rate of savings and rate of return were arrayed and the median for each array was found. Each median was given an index number of 100, and all other rates in the array were given index numbers corresponding to their median. The effectiveness index for each firm was the average of the indexes of the two measures, rate of savings and rate of return. The arbitrary decision of dividing the associations into two groups would not change the general conclusions, but will help give specific results to this study.

Variables influencing degree of success were selected in the following ways; (1) suggestions of cooperative advisors, (2) observation and study of the data and (3) general knowledge.

Extension of credit, the first variable studied, was defined as the number of average day's sales which were equivalent to the dollar amount of accounts receivables at the end of the fiscal year. Simple linear regression analysis was used to analyze the relationship of days of sales in accounts receivable and effectiveness index. There was no significant relationship between these two variables in the 149 associations. The 149 associations were divided into size groups, small (39) associations and large (110) associations. There was no significant relationship between the two variables in the small and large size groups. Although the regression lines obtained above were not significant their slope might be explained by the relation of total expenses and gross margin with days of sales. When the slope of the regression line for the relation of effectiveness and days of sales was positive, there was a surplus of gross margin over expenses in that group. The opposite was true for a negatively sloped regression line. The small group had a positively sloped regression line while the large group and all associations had negatively sloped regression lines.

It was concluded that as more credit was extended the effectiveness index was not affected. The slope of the regression line suggests that the large associations perhaps need to be more careful in extending credit than the small associations.

Size of business was found by simple linear regression to influence the effectiveness index. The regression coefficient (.292) was significant, therefore, each increase of $1,000 sales would increase the effectiveness index .292. In order to obtain an effectiveness index of 100 the firm would need $398,904 sales.

Total expenses, gross margin and percent of member equity invested in the local cooperative were also found to have a significant relationship with the effectiveness index.

A multiple regression function was formulated with these four independent variables to find the net effect of each on the effectiveness index.

The regression coefficient found for size of business was not significantly different from zero. This would suggest that size of business, when the influence of other independent variables are taken into account, had no significant effect on the effectiveness index.

Chi square analysis was used to determine if there was any variation in the chances of effectiveness as the size of business varied. Since medians were used in calculating the index and for establishing the division between effective and ineffective associations, the hypothesis was assumed to be 1:1 ratio. Associations were divided into three size groups according to sales, under \$100,000, \$100,000 to \$200,000 and over \$200,000. The large size group was found to be significantly different from the H_0. Contingency chi square was found to be significantly different from the H_0. Therefore, size groups varied according to their percentages of effective associations. To determine where the true percentage would lie, below 50 percent or above 50 percent, the use of confidence intervals of 99 percent were used. The interval for the small group was 23.6 percent to 64.75 percent and the interval for the large group was 49.4 percent to 84.5 percent. This suggests that chances for the percentage of effective associations to be above 50 percent would be greater in the large size group than in the small size group.

A significant relation between size and gross margin and between size and total expenses would show any economies or diseconomies of scale. The simple regression coefficients for these two relationships were found not to be significantly different from zero. The findings of these relationships would express neither economies nor diseconomies of scale.

It cannot be said that there was a relation between size of business and effectiveness. Neither can it be said that there was no relationship between these variables. It can be said from the study of these data, however, that there seems to be a better chance of effectiveness in an association which had \$200,000 sales than in one which had less than \$100,000 sales.

The third variable discussed in this study was investment of member equity in the local cooperative. The regression coefficient for this variable was found to be 3.96 and significant, therefore, it would have an influence on the effectiveness index. By holding the three independent variables (gross margin, total expenses and size) constant at their average, and varying investment, it was possible to find a regression line showing what approximate influence investment had on the effectiveness index. To obtain an effectiveness index of 100 or more the firm would need 74.56 percent of its member equity invested in the local cooperative.

The other two factors used in the multiple regression function were gross margin and total expenses. These two factors were found to be significant and had the greatest influence on the effectiveness index. The regression coefficients were 45.46 for gross margin and -43.87 for total expenses. By varying the gross margin and holding the other three variables constant at their average, these data showed the firm would need 19 percent or more gross margin to obtain an effectiveness index of 100 or more. By varying total expenses and holding the other three variables constant at their average, the firm would need 15.09 percent or less total expenses to obtain an effectiveness index of 100 or more.

The percentages of the three independent variables; gross margin, total expenses and investment, needed to obtain an effectiveness index of 100 might be used as standards for an effective cooperative in this study. The correlation coefficient of the multiple regression function was .757. R squared was .573, which means that these four independent variables explain about 57 percent of the variation in the effectiveness index.